THE PRINCIPLES

OF

ANATOMY AND PHYSIOLOGY

APPLIED TO THE

Preservation of Health.

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BOSTON:
JORDAN & CO. 121 WASHINGTON STREET.
DOW AND JACKSON, PRINTERS.
1844.

PREFACE.

Every medical man must have felt and lamented the ignorance so generally prevalent, in regard to the simplest functions of the animal system, and the consequent absence of judicious co-operation, in the care and cure of the sick. Let it not be said that knowledge of this description is superfluous to the unprofessional reader; for society groans under the load of suffering produced by causes susceptible of removal, but left in operation in consequence of our unacquaintance with our own structures, and of different parts of the system to each other, and of the objects which surround us. It is a fact admitted by all intelligent persons, that most of the bodily sufferings endured by mankind are penalties of violated physical law, and as in the civil code, so in the economy of health, "ignorance of the law excuses no one."

Although nature may not always inflict the penalty immediately on the act of transgression, yet she keeps a most rigid record of all violations and delinquencies, and will sooner or later bring the transgressor to a fearful reckoning. It is not the design of the author here, to enter into a lengthy discussion of the subjects referred to; but to present to the reader, and especially to the young, some important facts and information with regard to the laws which govern our being, which if carried into practice may prove useful to all who may chance to receive it, and also to present it in a brief and comprehensive pamphlet form, so that the limited means of none shall preclude its perusal.

J. B. W.

ANATOMY AND PHYSIOLOGY.

Anatomy is that branch of knowledge which investigates whatever enters into the composition of animated beings; while Physiology, in its limited sense, explains the uses of the various parts of the living body. Both are divided into Comparative and human, the former relating to inferior animals, the latter of course to man. We shall confine ourselves in this little work to that which relates to man. When the allwise Creator determined on making beings which should be able to move from place to place, he contrived for them an organization different from that of beings which were fixed; considered in this light, the animal frame is the most wonderful of all organizations of machinery. No production of art can be compared with it for the multiplicity and nicety of its evolutions, and yet all these are executed by muscular power acting upon the bones, and changing their relative positions. The incalculable variety of movements required of man is the reason why the bones composing the skeleton are so numerous, and each so admirably connected with the others by articulation. The advantages of this arrangement are no less obvious than admirable. Had the osseous framework consisted of one entire piece, not only would man have been incapable of motion, but every external shock would have been communicated undiminished to the whole system: whereas, by the division of parts, and by the interposition of the elastic cartilages and ligaments constituting the joints, free and ex-

tensive motion is secured. The fabric resulting from the connection of all these pieces in their natural order of arrangement is called the *Skeleton.* The number of bones in the human skeleton is about 250, divided by anatomists into those of the head, trunk and extremities. The bones of the cranium or skull are eight in number, viz : the frontal or bone of forehead, twe parietal or wall bones, one occipital or back bone of the head, two temporal bones situated before and above the ears, one ethmoid and one sphenoid bone situated in the internal part of the head ; all of which surround and form a complete protection for the brain from all ordinary accidents, and also to the organs of hearing, seeing smelling and tasting. Protection and not motion being the sole object of its construction, the numerous bones of which it is composed are joined to each other, not by movable joints like other bones, but by a kind of dovetailing, which combines the solidity of continuous structure with the advantages which their separation gives in facilitating growth, and preventing the extension to all the injuries inflicted on one. The bones of the face are fourteen in number; consisting of two superior maxilary or upper jaw bones, one inferior maxilary or lower jaw bone, two malar or cheek bones, and several smaller bones which it would be unintelligible to the general reader to attempt to explain. There are eight small bones belonging to the ears four on each, side, one at the root of the tongue called the os hyoides, and thirty-two dentas or teeth. The four front teeth in each jaw are called the incisor or cutting teeth, the two next on each side of the face in both jaws the cuspidati or sharp-pointed teeth, the two upper of which are vulgarly called the eye teeth, and the remaining twenty the mo lares or grinders. Each tooth may be divided into two parts, viz. its body, or that which appears above the gums and its fang, or root, which is fixed in the socket. Every tooth is composed of its enamel, its internal or bony substance. The enamel is the hard white substance which surrounds the body of the tooth. When broken it appears fibrous or striaeted ; and all the striae are directed from the circumference to the centre of the tooth.

This enamel is thickest on the grinding surface, and on the cutting edges or point of the tooth, becoming gradually thinner as it approaches the neck, where it terminates insensibly. Each tooth has an inner cavity, which, beginning by a small opening at the point of the fang, becomes larger, and terminates in the body of the tooth.—The cavity is supplied with blood-vessels and nerves, which pass through the small hole in the root. In old people this hole commonly closes, and the sensibility of the tooth is destroyed.

The teeth are likewise secured in their sockets by a red substance called the *gums*, which every where covers the alscolar processes, and has as many perforations as there are teeth. The gums of infants, which perform the office of teeth, have a hard ridge extending through their whole length ; but in old people, who have lost their teeth, this ridge is wanting. The teeth are subject to a variety of accidents and pains. Odontalgia or toothache is a disease of very common occurence. It usually attacks the molares or grinders, reaching sometimes up to the eyes, and sometimes back into the cavity of the ear. At the same time there is a manifest determination to the head, and a remarkable tension and inflation of the blood-vessels takes place, not only in the parts next to that where the pain is seated, but over the whole head. The toothache is sometimes merely a rheumatic affection, arising from cold, but more frequently from a carious or rotten tooth. It is also a symptom of pregnancy, and takes place in some nervous disorders. It may attack persons at any period of life, though it is most common to the young. Many empirical remedies have been proposed for the cure of this painful disease, but none have afforded permanent relief. When the affection is purely rheumatic, blistering behind the ear will almost always remove it ; but when it proceeds from a defect in the tooth the pain is much more obstinate. The celebrated Boerhaave is said to have applied opium, oleum caryophyli, camphor, and alcohol upon cotton. When the constitution has had some share in the disease, the sulphate of quinine has been recommended, to be taken internally, on

account of its tonic and anti-septic powers. But very often all these will fail, and the only infallible cure is to draw the tooth.

We next come to the bones of the body or trunk. The spine or back bone consists of twenty-four small pieces, termed vertebra, from the Latin word *vertere* to turn, as the body turns on them as on a pivot. Of these, seven are called *cervical* vertebra, belonging to the neck; twelve dorsal vertibrae, connecting the ribs at the back; and five lumbar belonging to the loins. The base of the column rests on the bone which connects the hip bones on the back of the pelvis, called the sacrum, below which is a small bone, the os coccygis, named from its resemblance to the cuckoo's bill, which terminates below what is called the back bone. The vertebra are firmly bound to each other in such a way as to admit of flexion and extension, and a certain degree of rotation, while by their solidity and firm attachment to each other, great strength is secured. Some conception of this strength may be formed, when we consider the enormous loads which some athletic men are able to carry on their shoulders, or raise in their hands, the whole weight of which is necessarily borne by the vertebra of the loins. As the space occupied by the abdomen gives large outward dimensions to this region of the body, it is only upon reflection that we perceive that the whole force exerted by the human frame in its most strenuous efforts, centres, ultimately, in the bony column of the spine. While the body of the vertebra affords support to the superincumbent parts, the projecting ridge behind, and rugged processes at the sides, combine with it to form a large tube or canal, extending from the top to the bottom of the column, in which the spinal marrow is contained and protected. Between each of the vertebra a thick compressible cushion of cartilage and ligament is interposed, which serves to unite the bones to each other, to diminish the shock in walking or leaping, and of admitting a greater extent of motion than if the bones were in immediate contact.

The ribs are twelve in number on each side, attached by their heads to the spine, and by their other (cartilag-

inous) extremities to the sternum or breast bone before. The seven uppermost are called true ribs, because the end of each is connected directly with the sternum or breast bone in front ; while the five lower are called false ribs, because one or two are loose at one end, and the cartilages of the others run into each other instead of being separately prolonged to the breast bone, that not extending so low as opposite the five false ribs. The use of the ribs is to form the cavity of the chest for the reception and protection of the lungs, heart, and great blood-vessels, and to assist in breathing by their alternately rising and falling, as this action enlarges and diminishes the size of the chest and the capacity of the lungs. The hip bones being connected before by what is called the os pubis, and in the rear by the sacrum, form the pelvis or basin, for the support of the viscera of the abdomen.

The bones of the upper extremities are, the clavicle or collar bone ; the scapular or shoulderblade ; the humerus or arm bone ; the radius and ulna or bones of the fore-arm ; and the small carpal and meta-carpal bones and phalanges, forming the wrist hand and fingers.

The scapula is the broad flat bone lying at the upper part of the back, familiarly known as the shoulder-blade, and so troublesome to many young ladies by its unhandsome projection. It serves to connect the arm with the trunk of the body, and gives origin to many of the muscles by which the arm is put in motion. The clavicle or collar bone extends from the breast bone outwards to the scapula. Its chief use is to prevent the arms from falling forward in front of the body ; and hence it is wanting in the lower animals, whose superior extremities are much closer to each other than those of man.

The humerus or upper bone of the arm is adapted by a kind of ball and socket joint to a corresponding surface in the scapula, and hence enjoys great latitude of motion, and is somewhat liable to dislocation. The radius and ulna, constituting the fore-arm, are connected with the humerus by a hinge-like joint, which admits readily of flexion and extension, but not of rotation ; and as the articulation is of a peculiar construction, it is rarely dislo-

cated. The movements of pronation and supination, or turning round the hand, are affected not by the elbow-joint, but by the radius moving upon the ulna, by means of joints formed for this purpose. The carpus or wrist consists of eight small bones, connecting the hand to the fore-arm, which are too complicated to admit of explanation here. The bones of the hand are five in number, which are united with those of the fingers, of which there are fourteen on each hand. The lower extremities consist of the os femoris or thigh bone, which is the largest bone of the human body ; the patella or knee-pan ; the tibia and fibula or leg bones ; and the tarsal and metatarsal bones, and phalanges, composing the ancle, foot, and toes.

The thigh-bone is connected to the body by means of a large round head, deeply sunk into a corresponding hollow in the pelvis, thus combining freedom of motion with great security. The thigh may be moved backwards and forwards as in walking ; and also outwards and inwards, as when sitting on horseback or with the legs crossed. The socket being mnch deeper than that of the shoulder joint, the thigh-bone has not the same range of motion as the the humerus, but has proportionably greater security.

The patella or knee-pan is well known. It is a small bone constituting the projection of the knee. It increases the power of the muscles which extend the leg, and protects the front of the knee joint. The tibia or shin bone is the principal bone of the leg, and is the only one connected with that of the thigh. Its lower end forms the projection of the inner ancle. The fibula is the long slender bone at the outer side of the leg, the lower end of which forms the outer ancle. Thus the tibia and fibula, together with the ancle joint, which, like that of the knee, are almost limited to flexion and extension.

The bones of the feet, twenty-six in each, display an admirable mechanism, but without plates any description of them would be unintelligible.

Our present aim being practical utility, we shall therefore pass over these details, and rather lay before the

reader several considerations of a more general and directly useful nature. And here I shall quote largely from Dr. Combe : Bones consist of two kinds of substances, those of an animal and those of an earthly nature. To the former belongs every thing connected with the life and growth of bones, and to the latter the hardness and power of resistance by which they are characterized.—The relative proportions of the animal and earthy constituents vary, however, according the period of life. In infancy the animal portion greatly predominates, and, consequently, the bones are at that age comparatively soft, yielding and elastic. In middle life the proportions are more equally balanced, and while the bones thereby acquire great hardness and solidity, they still preserve some elasticity. In old age, on the contrary, when the earthy constituent predominate, they become dry, brittle, and comparatively lifeless.

A very important purpose is served by the different proportions which the animal elements of bone bear to the earthy, at different ages. In early youth, when much strength is not wanted, as the body is not exposed to severe efforts, but when a greater growth of bone is required to complete the development of the human frame, the animal or living part of the bone is observed to be predominant. But in middle life, when growth is finished, and when nutrition is required only to repair waste, a larger proportion of the solid or earthy, and a smaller proportion of the vital constituents becomes necessary. In old age, again, when the wants of the system are reversed, and when positive diminution of existing masses is required to put the frame into harmony with the shrunk muscles and feebler powers of life, the absorbent vessels carry away more of the vital matter, leaving chiefly the earthy, which, being less susceptible of change, requires scarcely any support from within ; and hence the brittle and compact hardness of bones, and their little capability of uniting when fractures happen at an advanced period of life. At birth, many of the bones are, properly speaking, of a cartilaginous nature. As the bones increase in growth, the cartilage is removed by the

absorbents, and its place supplied by a kind of cellular membrane, in the interstices of which the earthy particles are deposited ; the two forming by their union, a homogeneous whole called bone. Although it is to the softer material alone that vital properties essentially belong, it is usual to speak of the life, the vessels, and the nerves of bones, as if life belonged equally to the earthy and animal portions. This is correct enough in reality, because the union betwen the earthy and animal tissues is always the product of life ; and the parts thus united are, to all intents and purposes, living parts. To carry on the processes of waste and renovation, by which every living structure is distinguished, all parts of the body are provided, first, with arteries conveying to them red or nutritive blood ; secondly, with exhalents, by which the new matter is deposited, and which are believed to be the minute terminations of the arteries ; thirdly, with veins by which the blood is carried back to the heart ; fourthly, with absorbent vessels, which take up and carry away the waste particles to be thrown out of the system ; and, lastly, with nerves to supply all these vessels, and the organs on which they are distributed, with that nervous energy which is essential to their vitality and to their connection with other parts of the system. The bones, insensible as they may seem, possess all these attributes of living and organized parts. They are all provided with blood-vessels, nerves, and with exhaling and absorbing vessels ; and they are constantly undergoing the same process of decay and renovation to which all other living parts are subjected.

That the bones are provided with blood-vessels is shown by the fact ,that anatomists are able to trace these vessels into their substance, and to inject those of a young subject with wax, so minutely as to make the bones appear of a lively red color. That they are provided also with nerves is evident, both from dissection and from the effects of injuries and disease. A healthy bone may be cut or sawn across without causing pain, but when the bone is inflamed, the most excruciating torture is felt.

And as sensation is the exclusive attribute of the nerv-

ous system, this fact alone would authorize us to assert their existence, even though nervous fibres could not be traced entering the osseous substance. It may be thought that bones are, in their very essence, so hard and durable as to render any such supply of nourishment and change of parts altogether unnecessary. But if we look for a moment to the advantages consequent upon this order of things we shall see abundant reason to abandon such an opinion.

In a state of health the bones are insensible to pain; and here, also, the most provident benevolence appears. For surrounded, as they are, by the softer and more sensitive parts, they afford them ample protection, while their insensibility enables them to act, for any length of time, without weariness or pain. But when a severe accident occurs to break them or to destroy their texture, pain then becomes their kindest guardian, and the sure promoter of their recovery. In such circumstances, indeed, nothing can be more truly benevolent than pain. It accompanies that inflammation and vascular activity, without which the work of reunion of the broken part cannot be accomplished; and is the means of securing the repose and quietude which are essential to the exact adaptation of the parts to each other, and which can be effected only by causing great pain to follow even the slightest motion.

Now, if this was not so, if pain did not guard the limb from motion when the process of recovery was going on, the union would be incessantly disturbed by every heedless and unavoidable start altering the relative position of the parts. This is frequently exemplified in practice.—Looking at these facts, it is impossible not to admire the wisdom and benevolence manifested in the adaptation of the structure of bones in every particular to the circumstances and occurrences of life.

We have already seen, that besides a large portion of earthy matter, which give to them dryness and hardness, bones contain a large quantity of animal matter, which is essential to their constitution. In early life this car-

tilaginous or gristly matter, predominates, and the bones are consequently less heavy, more pliable and elastic, and possessed of greater vitality. In old age, again, the earthy part predominates, and with it fragility, and a less degree of vitality. It is from this difference that bones broken in youth reunite in much less time than their reunion is effected in advanced life.

The practical application to be made of our knowledge of the constitution of the bones, as parts of our animal frame, and as governed by the ordinary organic laws, will now be obvious. Their health we have seen to depend on their regular supply of nourishment by the blood-vessels, on a due supply of nervous energy by the nerves, and on a due balance between the action of the nutriment and absorbent or removing vessels. To the steady observation of these conditions, therefore, we are required to attend.

It is a common fault to consider the study of an organ or function complete, when we have viewed it on all its sides as an isolated part, with regarding its external relations as constituting an essential portion of its history. Thus, although we examine the structure and functions of the heart, and see that it is a muscle, and that its office is to contract, our knowledge of it is imperfect if we do not go still further, and see that *blood* is the stimulant which causes its contractible power to act. And, in like manner with the eye, whose relations to light are as essential a part to its constitution as the transparency of its membranes or the convexity of its lens. Now, in the case of the bones, we are apt describe their hardness, their mobility, and other qualities, without sufficiently adverting to the fact that, being organs of resistance and motion, the frequent and regular performance of motion and resistance is as essential to their well-being, as blood is to the heart, air to the lungs, or light to the eyes. And, therefore, when that condition is not fulfilled, the bones become feeble, diseased, and unfit for their functions, just as the softer parts of the body do. In practice it is of the utmost importance to be fully aware of this fact.

It is familiar to the professional mind, that a part de-

prived of that exercise or action which nature destined it to fulfil, becomes weakened and diminished in size. The bones are the solid organs of motion ; and unless they be duly exercised in effecting motion, they, like the muscles which move them, suffer and decay in virtue of that universal law which requires exercise as the condition of their well-being—as the stimulus necessary to their existence.

In early youth, in particular, when every part teems with life and activity, and is almost hourly acquiring an increase of dimensions, the nutrient system is in a state of unceasing and powerful action, and an abundant supply of nourishing food is indispensable to health. Nature points out this fact, in the keen and vigorous appetite and strong powers of digestion which every healthy child uniformly manifests. This law of exercise, as influencing nutrition and growth, is universal in its application, and applies to the osseous as much as to any other system. If the bones are duly exercised in their functions of administering to motion, then active nutrition goes on, and they acquire dimensions, strength and solidity. If they are not exercised, the stimulus required for the supply of blood to them becomes insufficient ; imperfect nutrition takes places ; and debility, softness, and unfitness for their office follow in the train. This cause of defective formation is most active and most commonly seen in the bones of the spine in growing girls, who are denied free exercise in that part ; and the consequent weakness in the bones and cartilages, as well as in the muscles, is a very frequent cause of distortions in the bones of young people, which no subsequent care can remove.

It must be observed, however, that defective nutrition may arise from other causes than inadequate exercise ; but, even then, the consequences attending it are analogous in their nature. Among the poorer classes of people of our cities, it often arises from deficiency of wholesome food, and from damp, dark habitations ; among the rich, from feeble digestion and assimilating powers, and pampering in diet ; and also from errors in clothing, neglect of sufficient ventilation, and due exposure to the

open air. Rickets, softness of the bones, and white-swellings are accordingly observed to be almost wholly confined to children belonging to one or other of these classes.

In the regular order of nature, the maturity and perfection of all organs and functions are attained at the precise time at which each is required. The bones of the infant are soft, vascular, full of life, and vigorous in growth ; but having no energetic motions to perform, they possess little power of solid resistance. In accordance with this condition of the bones, the muscles which move them are small, gelatinous, imperfectly fibrous, and little capable of powerful contraction. If the bones had been made solid and heavy, from the beginning, they would not only have been inert and cumbrous masses, destitute of muscles capable of putting them in motion ; but, possessing less vitality, they would not have grown with the rapidity necessary to adapt themselves to the growth of the other parts of the system. If, on the other hand, powerful muscles had existed from the first, they would have served only to twist the soft and yielding bones into irregular shapes. Or, if both solid bones and strong muscles had been given from birth, then a complete power of locomotion would have been the result, which from the absence of intellect, and of knowledge of the external world to direct it, would have led to incessant evils, if not to speedy destruction. But as things are arranged, the most profound wisdom and the purest benevolence show themselves in the beautiful adaptation of all the parts and functions to each other, and to one common end.

Knowledge of the bones and of their several conditions at different periods of life, is not without its practical uses. Especially is such knowledge useful in the treatment and the care of children. Some fond parents, disregarding the fact that the bones are comparatively soft and pliable in infancy, and in their haste to see the little objects walk without support, are often soliciting attempts at standing or walking, long before the bones have acquired sufficient power of resistance, and the muscles sufficient power of contraction, to compete with the laws

of gravitation. The natural consequence is a curvature of the bone, which, yielding like an elastic stick, becomes curved under the weight of the body. The two ends approach nearer to each other than they ought, and, of course, the muscles become shorter on one side than on the other.

Thus we have breifly adverted to the several parts of the osseous system, which we will term *Osteology*.

We will now turn our attention to that part of the subject which will come within the province of Physiology. We will first speak of digestion :

The word digestion is derived from the Latin word *digere* to dissolve. As used in Physiology, it signifies the change that the food undergoes in the stomach, by which it is converted into chyme, of which the chyle is subsequently formed as matter destined for the reparation of the animal economy.

The apparatus by which it is accomplished is of a very complicated kind. It is less so in those animals who live on substances similar to their bodies, as in the carnivorous animals, or those that feed on flesh, than in those that subsist on substances of a dissimilar character, as in herbivorous animals or those that live on vegetables. Man can derive nourishmsnt from almost every article of food, and on this account he has been called an omnivorous animal. His digestive apparatus is, therefore, less complex than that of the herbivorous animals, but more so than the strictly carnivorous ones. The organs of digestion consists of the mouth and its appendages, the stomach and the intestines. The teeth perform an important part in preparing food for the stomach, and have already been explained. The tongue also assists in mastication or chewing, by removing the food from one part of the mouth to the other, and forming it into the most convenient shape. The tongue is a muscular organ of great power. The saliva is poured into the mouth by means of three pairs of glands, and is an important agent in digestion. The largest of these glands are called *parotid*, from being situated about the ear. The tube which conveys their secretion to the mouth, passes through the mus-

cle of the cheek, and has been called the duct of Steno, from the anatomist who discovered and described it. It is the gland which is the seat of the disease known by the name of mumps. The sub-maxillary glands are situated under the lower jaw, and the sub-lingual under the tongue. It is computed that not less than eight ounces of saliva are poured into the mouth at every full meal. In immediate connection with the mouth, and situated in the posterior part of it, is the pharynx, so called, which is the commencement of the passage to the stomach. It is of an irregular form, being considerably larger at its upper than at its lower extremity. Its continuation down to the stomach is called the œsophagus. It is by means of the pharynx and œsophagus that the art of deglutition or swallowing is effected.

The stomach is the largest organ of digestion. It lies directly across the body, just under the diaphragm or midriff, the great muscle which separates the chest from the abdomen. The œsophagus or gullet enters it in the upper part of the left extremity, which is much larger than the right.

The opening into the stomach is called the cardiac orifice, from its being near the heart, and the opening from it into the intestines, the pyloric orifice, from its guarding the entrance. The stomach of an adult, in its ordinary state of distension, is capable of holding about three pints; but being of an elastic nature is susceptible of being distended to greater dimensions. Hence we see the impropriety of crowding the stomach with unnatural and heterogenous substances, as many persons do, as though the end for which they were created was to eat and devour, instead of eating to answer the design of their being. It has been said by an author, on diet, that "nearly one half of the diseases and deaths occurring during the first two years of existence, are owing to errors in diet."

The power of digestion is limited to the amount of gastric juice the stomach is capable of providing; exercise, in the open air, promotes the secretion of the gastric juice. It is a good rule to proportion the quantity of our food, in a great measure, to the amount of exercise we take:

and if that exercise has been in the open air there is less danger of excess. The person of sedentary habits, who scarcely walks abroad, should eat very sparingly, or he will be troubled with nervousness, headache, and all the horrors of indigestion.

Young persons, who are growing, should have plenty of food ; if they are active and healthy, and the food is of a proper kind and well prepared, there is little danger of their taking too much. But never tempt their appetites by delicacies, when plain food is not relished. When the growth is attained, and when childhood sports and exercise are in a great measure abandoned—as is the case with females, particularly,—then great care should be taken to regulate the appetite, and never to take such a quantity of food at a time as to oppress and disturb the stomach.

Variety in food is chiefly dangerous, because it tempts to excess ; otherwise it is beneficial. Let no person think he or she is certainly temperate, because but one kind of food is eaten. It is more hurtful to take too much of one, than to use the same quantity of several kinds.—Meats should always be sufficiently cooked. It is a savage custom, too generally preval ent, to eat meatin a half-raw state, and only a very strong stomach can digest it.

The diet should always be more spare, with a large proportion of vegetables and fruit, during summer. Ripe fruits eaten temperately, in their season, are wholesome. Food should never be eaten when it is hot--bread is very unwholesome when eaten in this way. Food should be eaten slowly. One of the most usual causes of dispepsia, arises from the haste in which we swallow our food without sufficiently chewing it. There ought to be one hour, at least, of quiet after every full meal, from those pursuits which tax the brain as well as those which exercise the muscles.

We next come to drink ; what shall we drink ? we will answer the question as the *Paddy* did, by asking another: What was the original drink of man, made for him by his Creator, while in the garden of Paradise ? You will an-

swer at once, the pure streams of Eden. Then, certainly, to the unvitiated appetite, pure water, used in moderate quantities, is the most wholesome beverage. Most people drink too much because they drink too fast. A wine-glass of water, sipped slowly, will quench thirst as effectually, as a pint swallowed at a draught. Dyspeptic people should be careful to take but a small quantity of drink at a time. Children require more in proportion to their food than adults. But it is very injurious to them to allow a habit of continual drinking, as you find in some children. It weakens the stomach, and renders them irritable and peevish. Coffee affords very little nourishment, and is apt, if drank strong, to occasion tremors of the nerves. It is very bad for bilious constitutions. Coffee, well prepared, and drank in moderation, by those who exercise much and take considerable solid food, may however, be used without much injury.

Strong green tea relaxes the tone of the stomach, and excites the nervous system. Persons of delicate constitutions are almost always sure to be injured by it. Black tea is much less deliterious. No kind of beverage should be taken very hot—it injures the health and impairs digestion.

At the pyloric orifice of the stomach, there is a membranous fold, which acts something like a valve, and which is supposed to be capable of preventing the exit of its contents till they have been sufficiently acted upon for the purpose of digestion.

The intestines in the human subject are usually from six to eight times as long as the individual to whom they belong. They are divided into small and large intestines, the former constituting about four-fifths of the whole. The small intestines are divided into the duodenum, the jejenum, and the ileum. The duodenum is so called from its length being about twelve fingers in breath ; and is abundantly supplied with absorbent vessels,called lacteals,from the resemblance of the fluid they contain to milk.

Mastication and deglutition are intimately connected with digestion. As soon as the food is taken into the mouth, it is cut by the incisor teeth, or ground by the

molar ones, according to the nature of it, into minute parts, and in this way becomes intimately mingled with the saliva. The powerful contraction of the muscles of the lower jaw, in mastication, increases the flow of this fluid. A large quantity of saliva is at all times poured into the mouth, but so long as we swallow with ease, we are not aware of the amount of the secretion. But this becomes evident when the throat is inflamed, or deglutition is effected from any cause. The presence of savory food in the mouth (or indeed the thought of a good meal when we are hungry) increases to a great degree the action of the salivary glands, and if mastication be properly performed, every particle of food becomes completely surrounded and mingled with the saliva. It is then carried by the action of the tongue and of the muscles of the mouth into the pharynx. This part of deglutition is voluntary ; but the passage of the food through the pharynx is wholly involuntary, and is performed very rapidly, so that no part of it may enter the windpipe, over which it passes. To prevent the introduction of any portion of the food into the windpipe or air-passages, a very simple, and, at the same time, a very effectual contrivance has been adopted. There is attached to the root of the tongue, a small cartilaginous body, called epiglottis, as it is intended to cover, under certain circumstances, the glottis or opening into the larynx, the organ of voice, which is the upper part of the windpipe. The ordinary position of the epiglottis is perpendicular, so as not to ob struct the passage of air to the lungs. But in the act of swallowing, the tongue is carried backwards, and the epiglottis is brought directly over the glottis, so as to completely close it. It remains in this state till the food has passed over it, and it is then restored to its ordinary position by the relaxation of the muscles and its own elasticity.

As the passage of the air to the lungs cannot with safety be long interrupted, it is necessary that this part of swallowing should be, as we see it is, rapidly performed.

As soon as it enters the œsophagus, it is carried slowly downward towards the stomach. It then enters the stom-

ach, and there undergoes a change, by which it is brought into a hemogeneous mass, neither fluid nor solid, which is called chyme. There has been great diversity of opinion among physiologists as to the mode in which this is effected· The opinion now generally received respecting the mode of digestion is, that a peculiar liquid secreted by the stomach, and called gastric juice, has a solvent power which enables it to reduce the food to an uniform mass. This is sometimes called the theory of chemical solution.

The solvent power of the gastric juice has been proved by many experiments. The celebrated Spallanani caused animals to swallow tubes with holes in them, containing food which had been previously chewed, and he found that it was converted into chyme. He tried similar experiments on himself, swallowing at first wooden tubes in which he put various articles of food ; but as these produced pain in the stomach, he substituted linen bags, and found that their contents were invariably digested. This he attributed to the solvent power of the gastric fluid, which penetrated the linen and dissolved the food. It is therefore certain that the gastric juice, while in the stomach, is capable of dissolving food taken into it ; and though evidently possessing a solvent power, yet it seems to be incapable of acting on anything endowed with life. Worms, while living, will often remain in the stomach uninjured, at a time when the hardest substances are undergoing solution ; but the moment these animals are dead they are dissolved by the gastric liquor.

It has been ascertained that, in a healthy stomach, the food, if not hard of digestion, is changed into chyme in four or five hours, and that before this has taken place, it is prevented from passing into the intestine, by a valve situated at the pyloric orifice of the stomach, called pylorus or door-keeper. It has been supposed by some that this valve has the property of determining when the aliment was sufficiently changed to allow it to pass, that it gives free exit to chyme, but contracts when undigested substances attempt to enter the duodenum. The food is not all converted into chyme at once, but as fast as it is

changed it passes into the intestine, only two or three ounces collecting in the pyloris extremity at a time.

After the food passes through the stomach it undergoes an important change in the first intestine, or duodenum, as it is called. In the stomach it is converted into chyme, and the process is called chymification: in the intestine it undergoes what is called chylification, in which it is brought into such a state, that a peculiar fluid called chyle is extracted from it by the absorbent vessels, whose mouths open in great abundance in this organ. The chyle is a thin substance somewhat resembling milk, and is the fluid which is afterwards converted into blood, for the nourishment of the body. The chyle differs in quality according to the food on which we subsist. If we have eaten much animal food, it will be of a white milky appearance; if not, it will be thinner and more transparent. It is not satisfactorily settled how the process of chylification is effected. It seems to be probable, however, that liquor from the pancreas, and the bile from the liver, are important agents in the process.

The chyle is afterwards absorbed by the lacteal vessels, and goes into the blood to repair the waste constantly going on in the body, while the other parts of the food, the excrementous matter, the nourishing part having been extracted from it, goes through the system and is ejected from the bowels.

We will now speak of the circulation of the blood. The agents by which this is carried on are, the heart, the arteries, and the veins. The heart is a hollow organ, of an irregular conical shape, and muscular and fibrous structure. Its situation is familiar to all, it being directly under where it is felt to beat. It rests on the diaphragm, the muscular membrane which separates the chest from the abdomen, and is supported at its base, which is uppermost, by the large blood-vessels with which it is connected. The heart in man is a double organ, and there is no direct communication after birth between its two parts. It is by one of these sides that the circulation is carried on in the lungs, and by the other throughout the rest of the body. The right side sends the blood to

the lungs, the left to the rest of the body. In the human heart there are four cavities, two auricles, and two ventricles. The auricles are situated at the upper part, and communicate freely with the ventricles. The vessels which convey the blood from the heart to the extremities, are called arteries. This name was given to them by the ancient anatomists, from a belief that they contained air. At the mouths of the two great arteries, that go off from the heart, there are three valves in each, which prevent the blood that enters the arteries from returning to the heart. There are no other valves found in any part of the arterial system. The veins are the vessels by which the blood is conveyed from the extremities to the heart. Many of the veins, especially in the extremities, are furnished with valves. It must be apparent even to a casual observer of vital phenomena, the blood is in perpetual motion during life.

The mode in which the common operation of bleeding from a vein, either in the leg or arm, is performed, is a convincing proof of the circulation of the blood. In bleeding from the arm, a ligature or bandage is placed around it above the point at which the vein is to be opened. The blood returning to it through the heart, is of course interrupted in its passage; the vein swells, because the artery, which is deeper seated and is not compressed by the bandage, continues to carry the blood to it, and if the vein is then opened below the ligature, the blood flows freely; but no blood is obtained if the opening be made above the ligature. The manner in which the bleeding from the vessels that are divided in surgical operations is stopped, is another proof of the circulation of the blood. In the amputation of an extremity, for example, that is, the removal of an arm or leg, the surgeon ties only the arteries. These carry the blood from the heart to all parts of the body, and the patient would soon bleed to death, unless some means were used to prevent it. The veins which carry the blood back to the heart, though they are usually as large as the arteries, do not bleed, and of course are not tied. But the reader by this time perhaps will ask, what is the cause of the circulation of the blood?

what sets and keeps it in motion during a whole life? There has been much diversity of opinion, says Dr. Hayward, among physiologists upon the question, whether the blood is carried through the arteries by the action of the heart alone, or whether the arteries themselves act upon their contents, and thus aid in the circulation of the blood. The point may still be considered unsettled. A great majority, however, incline to the opinion, that it is effected by the combined action of both. The action of the heart must be referred to the vital principle. It may then be said, that the blood is carried through the arteries chiefly by the action of the heart, aided, perhaps, by the elasticity and contractile power, which reside in the arterial coats; that the circulation through the capillary system is effected entirely by the capillaries themselves, and that the blood is thrown by them, into the ring, probably by the combined action of the causes just mentioned.

It has been estimated that two ounces of blood are thrown out of the heart at each contraction of the ventricle or pulsation, and that the blood constitutes about one-fifth part of the weight of the body. It follows, therefore, that the quantity of blood is different in different individuals according to the size of the body, varying in healthy adults from twenty-five to thirty-five pounds, and in some cases even more than this. Now suppose that there are seventy pulsations in a minute, the whole blood of the body, even allowing it to amount to thirty-five pounds, must pass through that organ in less than three minutes. And so important is the action of the heart, that if it be suspended for a moment, death ensues. How beautiful and well adapted are the lines of the excellent Dr. Watts:

Our life contains a thousand springs,
And dies if one be gone;
Strange that a harp of thousand strings
Should keep in tune so long!

That this organ, constructed apparently of such frail materials, and exposed to such great irregularity in action during a long life, should perform its functions so

perfectly, is calculated to give us the most exalted ideas of the power and wisdom of the Creator of our bodies.

The blood is the fluid from which all other parts of the body are formed. When drawn from the body, it soon separates into two parts, one liquid and the other solid, which floats in it; the liquid is called serum, and the solid crassamentum. This change is called the coagulation of the blood, and takes place in about seven minutes after it is drawn from the body. The average temperature of blood is about one hundred degrees of Fahrenheit's thermometer. All parts of the body, as before remarked, are formed from the blood, however dissimilar they may be in appearance, structure, and properties. From it is secreted all the solids as well as the fluids; and some of the solids seem to possess properties very unlike those of the blood, as the hair, the nails, and the bones. It is the blood that repairs the waste that is going on in our organs, and it also gives a stimulus to the brain and nervous system, without which they would be incapable of action. If the ordinary supply of blood that is sent to the brain be cut off, its functions are immediately suspended; and if blood be carried there which has not undergone the changes which are effected in it by the lungs, its functions are destroyed.

Respiration or breathing is the process by which air is taken into the lungs and expelled from them. The act by which the air is taken in, is called inspiration, and that by which it is thrown out is called expiration. The respiratory apparatus embraces all those organs, which perform any part in the mechanical process of respiration. The windpipe is a tube composed of cartilaginous rings, extending from the mouth into the lungs. It is situated in front of the passage to the stomach, and at its upper extremity there is a valve, the epiglottis, already noticed, which prevents the entrance of foreign substances into it. As soon as the windpipe reaches the lungs, it is divided into two parts, one going to each side, and called the bronchus, which is the seat of bronchitis. These subdivide into numerous smaller branches, which finally terminate in air cells. The lungs occupy a large

part of the cavity of the chest. They are divided into five parts or lobes, three on the right side and two on the left. They are composed almost entirely of air-tubes, air-cells and blood vessels; these, with the cellular membrane that connects them, constitute, in fact, their whole substance.

They are so vascular, that after air has once been admitted into them, they are lighter than water. A knowledge of this fact has led to a mode of determining whether infants supposed to have been murdered, were born alive or not. If the lungs would float in water, it was decided that the children must have breathed, and of course have been born alive; if on the contrary they sunk, it was considered a proof that they had never breathed. The lungs in the inferior animals are known by the popular name of lights. The air-tubes and air-cells are lined by a mucus membrane, and the lungs are covered on the exterior by a serous membrane called the pleura, which is the seat of the disease known by the name of pleurisy. This membrane not only covers the lungs on the exterior, but lines also the chest, and is constantly lubricated in health by a serous fluid which is exhaled from it.

The air we take into the lungs in the act of breathing, and without which life could not be sustained, is a compound fluid, consisting of twenty-one parts of oxygen, seventy-eight parts of nitrogen, and one part of carbonic acid gas. The quantity of air thrown out of the lungs, is somewhat less than that which is taken into them. Some physiologists have fixed the amount lost at one eightieth part of the volume taken into the lungs; which would be about half a cubic inch at each inspiration. The quantity of azote or nitrogen, is nearly the same under ordinary circumstances, in expired air as in inspired. The quantity of oxygen is diminished by inspiration, and that of carbonic acid gas is increased. The object of respiration seems to be to bring the blood in contact with the air in the lungs, where it undergoes a change, rendering it suitable for the purposes of nutrition. When it is recollected, that atmospheric air is alone capable of permanently supporting respiration, and that every adult

individual perspires about one million cubic inches in every twenty-four hours; when it is borne in mind how essential this process is to health and even life, that the functions of the body cannot be perfectly performed if the lungs be not properly supplied, that the spirits are depressed and the energies of the mind impaired, it must be obvious that too great care cannot be taken that the apartments in which we live should be well ventilated, that too many persons should not be crowded together, and thus be compelled to breathe air which has been already respired, but that the lungs should be constantly furnished both by day and by night, with that air which can alone impart vigor to the physical and intellectual system.

There are other actions of common occurrence, intimately connected with respiration, such as sighing, yawning, coughing, sneezing, laughing and hiccup.

Sighing, consists in a full and long-continued inspiration; its purpose, when it is not connected with the state of the mind, seems to be to facilitate the passage of the blood through the vessels of the lungs.

Yawning, like sighing, consists of a full and protracted inspiration; but it differs from it in being followed by a slow expiration, and by being attended by an involuntary distention of the jaws.

Coughing, is produced by a quick and powerful contraction of the diaphragm, which distends the lungs with air, and this is driven forcibly by the contraction of the abdominal muscles through the trachea, for the purpose of expelling any foreign or irritating substance that may be lodged there or in the lungs.

Sneezing, is an involuntary action, caused by some irritating substance applied to the mucous membrane of the nose.

Laughing, is the effect of an inspiration, succeeded by short, rapid, and imperfect expirations.

Hiccup, is produced by a convulsive, rapid and involuntary contraction of the diaphragm. In a low state of protracted disease, it is an alarming symptom, and not unfrequently precedes dissolution.

A knowledge of the structure and functions of the lungs, and of the conditions favorable to their healthy action, is, therefore, very important; for on their welfare depends that of every organ of the body. And when we consider the vast number that annually fall victims to pulmonary consumption, and that these are mostly among the young and promising, we cannot but feel deeply interested in obtaining some acquaintance with the organization which is the seat of that affection, and with the conditions most conducive to the due performance of its functions and the preservation of its health.

From the explanation already given of the structure and uses of the lungs, it is obvious that several conditions, which it is our interest to know and observe, are essential to the healthy performance of the important function of respiration. And first, we may remark, among these is a healthy original formation of the lungs. No factin medicine is better established, than that which proves the hereditary transmission of parents to children of a constitutional liability to pulmonary disease. Another requisite to the well being of the lungs is, a due supply of rich and healthy blood. When, from defective food or impaired digestion, the blood is impoverished in quality and rendered unfit for adequate nutrition, the lungs suffer, and that often to a fatal extent. So certain is this fact, that in lower animals, it is stated, tubercles (the cause of incurable consumption) can be produced in the lungs to almost any extent, by withholding a sufficiency of nourishing food.

The free and easy expansion of the chest, is obviously indispensable to the full play and dilatation of the lungs; whatever impedes it, either in dress or position, is prejudicial to health; and on the other hand, whatever favors the free expansion of the chest, equally promotes the healthy fulfilment of the respiratory functions.

Corsets and tight lacing operate most injuriously, by compressing the thoracic cavity,and impeding the due dilatation of the lungs, and in many instances, they give rise to pulmonary consumption Cases have been produced, in which the liver was actually indented by the extreme

pressure, occasioned by the suicidal practice of excessive lacing. This destructive habit cannot be too highly censured by all medical men, and especially by those who have the training of young females. Mothers who allow their daughters to destroy their healths in this way, cannot be innocent. Some may say they would prevent it if they could. Such futile excuses are useless. Had you been faithful and just with your child in infancy, you could now govern it without difficulty. For the behavior of every child who is not strictly moral and virtuous, his parents (if he have them) are almost, if not entirely, responsible. One of the greatest evils of our beloved country, and one which perhaps as much as any other threatens to destroy its peace and prosperity, exists in the parental education of our youth. The reader will pardon my thus digressing, as this is a subject of so much vital importance.

The admirable harmony established by the Creator between the various constituent parts of the animal frame, renders it impossible to pay regard to, or infringe the conditions required for, the health of any one, without all the rest participating in the benefit or injury. Thus, while cheerful exercise in the open air and in the social circle is directly and eminently conducive to the well-being of the muscular system, the advantage does not stop here; the beneficent Creator having kindly so ordered it, that the same exercise shall be scarcely less advantageous to the proper performance of the important function of respiration. Active exercise calls the lungs into play, favors their expansion, promotes the circulation of the blood, and leads to their complete and healthy development. The same end is greatly facilitated by that free and vigorous exercise of the voice, which so uniformly accompanies and enlivens the sports of the young, and which doubles the benefits derived from them, considered as exercise.

The excitement of the social and moral feelings among children engaged in play, is another powerful tonic, the influence of which on the general health ought not to be overlooked; for the nervous influence is as indispensable

to the right performance of respiration, as it is to the action of the muscles or to the digestion of the food.

But as we have already enlarged more than was intended in the commencement, we shall be obliged to pass over many points and even parts of the subject, of extreme interest, by referring the reader to large professionsal works; and close this little work, after stating a few fact connected with the decay and dissolution of the body. And here I shall quote in substance from the celebrated Haller. But as those causes operate incessantly in rendering the matter of the body more dense, in diminishing its irritability, and in augmenting the quantity of earth, it is not possible but decrepit old age must succeed. In it, the senses become partially destroyed, and the vis insita of the muscles becomes exceedingly weak, so that the limbs lose their strength, and become, especially the legs, unable to direct the body; that the callous insensibility of the nerves cannot be excited to perform the office of generation; that the very intestines, becoming torpid, do not obey the habitual stimuli; that, by the induration of the intervertebral cartilages, the body bends forward; that by the falling out of the teeth, the jaws, now rendered shorter, do not support the lips sufficiently; and lastly, that the pulsations of the heart become one half less frequent than in the infant state.

Thus at last, the necessity of natural death approaches, although the greatest number of persons are carried off prematurely by disease. One in a thousand, perhaps, arrives to the age of ninety, while scarcely any exceed a hundred. Man is long lived when compared with other animals; he is also more tender than any of them, has looser flesh and less hard bones. It is not easy to say what was the cause in long lived people of their longevity. One cause seems to exist in the habits, to a considerable degree at least, to sobriety, temperate diet, peaceable disposition, a mind not endowed with very great vivacity, but cheerful, and little subject to care.

Death from old age happens sometimes, but rarely. It may be said to occur, when the powers gradually decay,

first, of the voluntary muscles, then of the vital muscles, and lastly of the heart itself; so that in an advanced age, life ceases through mere weakness, rather than the oppression of any disease. The heart becomes unable to propel the blood to the extremities, the pulse and heat desert the feet and hands; yet the blood continues to be sent from the heart into those arteries nearest to it, and to be carried back from thence; the flame of life is thus supported for a little while, which soon after we perceive to be extinguished; when now the heart itself, being totally deprived of its powers, and not irritable by the blood to any effectual motion, cannot propel the blood through the lungs, that the great artery, the aorta, may receive its due quantity. The last efforts of respiration are now exerted, to open a passage for the blood through the lungs, until even the powers given by nature for performing the act of inspiration, becoming unequal to their task, cease. Then, the left side of the heart neither receives the blood nor is irritated, and therefore remains at rest; while yet for a little time, the right ventricle, and lastly the auricle of the same side, receive the blood brought by the veins from the cold and contracted limbs, and being irritated by it, continue to beat weakly.

But at last, when the rest of the body has become cold, and the fat itself congealed, even this motion ceases, and death becomes complete. I shall call that death, says Haller, when the heart has become totally deprived of irritability; for its mere quiesence is not without hope of recuscitation: neither does the putrefaction, or insensibility, or coldness of any part of the body, demonstrate the death of the whole system; but all these things when joined together, and perpetually increasing, with the rigidity produced by the congelation of the fat, in consequence of rest and cold, afford the signs of death in any doubtful case. The body after death is decomposed and destroyed by putrefaction. Thus the fat, and the water, and the gluten, being resolved, are dissipated; the earthy matter deprived of its bonds of union, insensibly moulders away and mixes with its mother dust. The soul goes to that place which God hath appointed it; and its indestruc-

tibility by death is proved incontrovertibly by a very common phenomenon; many people, when their bodily powers are wasted and spent, give evident proofs of a highly serene, vigorous, and even cheerful mind.